

LB/DON/27/04

Effective Infrastructure Management in Software Development Firms in Sri Lanka

By
Rasanga Chinthaka Keeriwela Gamage

This research dissertation was submitted to the Department of Management of Technology of the University of Moratuwa in partial fulfillment of the requirements for the Degree of Master of Business Administration in Management of Technology



Supervised by
Professor Ananda Jayawardena

University of Moratuwa



79643

Department Of Management Of Technology
University Of Moratuwa, Sri Lanka
December 2003

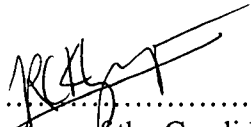
UM Thesis Coll.

79643

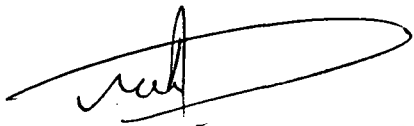
79643

DECLARATION

"I certify that this dissertation does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any University to the best of my knowledge and belief it does not contain any material previously published, written or orally communicated by another person where due reference is made in the text."


.....
Signature of the Candidate
R. C. Keeriwela Gamage

To the best of my knowledge, the above particulars are correct.



.....
Supervisor
Professor A. K. W. Jayawardena
University of Moratuwa



University of Moratuwa, Sri Lanka
Electronic Theses & Dissertations
lib.mrt.ac.lk

Abstract

Efficient and effective IT infrastructure management is one of the most challenging tasks facing senior managers who often feel ill equipped to make important decisions. Implementing right infrastructure at the right time enables rapid implementation of electronically based business initiatives and cost reduction of current business processes.

Using a survey this research analyzes six components of infrastructure management in software development firms in Sri Lanka. The components explored in this study are technology transfer, technology usage, technology needs assessment, technology change, technology evaluation and resource planning.

By studying 7 software exporting firms out of 44 software exporters the most important factors in infrastructure management, which affect revenue and infrastructure expenditure were identified.

The results suggest that, among all the infrastructure management factors technology usage and technology transfer were the most significant factors, which affect a software development organization's revenue. Implications of the results are discussed.

The dissertation concludes with a new strategy for increasing the efficiency and effectiveness of a software development company. A set of procedures are defined to make each infrastructure management component efficient and effective in the new strategy. Standards and guidelines should be transferred for efficient technology transfer and for efficient technology usage procedures such as technology identification, selection of appropriate technology, server consolidation, monitoring and tuning, budgeting, security implementation are important. Creation of yearly purchase plan, procurement of PCs, laptops and desktops according to plan, utilization of human resources for infrastructure management tasks, efficient inventory management, software and infrastructure back up, competency development are the important tasks in resource planning. Technology needs assessment, technology evaluation and technology change are other procedures included in the strategy.

Table of Contents

| | |
|-------------------------|-------------|
| <i>List Of Figures</i> | <i>Vii</i> |
| <i>List Of Tables</i> | <i>Viii</i> |
| <i>Acknowledgements</i> | <i>X</i> |

| | |
|---|-----------|
| 1. INTRODUCTION | 1 |
| 1.1 Background..... | 2 |
| 1.2 Problem Domain..... | 2 |
| 1.2.1 Problems With Most Of The Infrastructures | 3 |
| 1.3 Project Description | 4 |
| 1.4 Justification..... | 4 |
| 1.5 Main Objectives..... | 4 |
| 1.5.1 Identify Technology Transfer Mechanisms | 4 |
| 1.5.2 Identify Technologies Transferred..... | 5 |
| 1.5.3 Problems Faced in Transferring Technology..... | 5 |
| 1.5.4 Identify Technology Usage..... | 5 |
| 1.5.5 Identify Resource Planning Methods..... | 5 |
| 1.5.6 Identify Technology Needs Assessment Methods..... | 6 |
| 1.5.7 Identify Technology Evaluation Methods | 6 |
| 1.5.8 Development Of A Model For Infrastructure Management Analysis | 6 |
| 1.5.9 Analyze The Identified Methodologies And Their Effectiveness | 6 |
| 1.5.10 Formulate a Strategy and a Methodology For Effective Infrastructure Management..... | 6 |
| 1.6 Organization of the Dissertation | 6 |
| 2. WHAT IS INFRASTRUCTURE MANAGEMENT..... | 9 |
| 2.1 Infrastructure | 10 |
| 2.2 Infrastructure Management..... | 12 |

| | |
|--|-----------|
| 2.3 Levels of Infrastructure Management | 13 |
| 2.3.1 Infrastructure Monitoring..... | 13 |
| 2.3.2 Infrastructure Management..... | 13 |
| 2.4 Summary..... | 14 |
| 3. LITERATURE SURVEY | 15 |
| 3.1 Introduction..... | 16 |
| 3.2 Modeling the IT-Infrastructure of Inter-Organizational Processes – Automation vs. Flexibility | 16 |
| 3.3 IT Infrastructure Optimization: The Fujitsu Approach..... | 19 |
| 3.4 Determinants of Organizational IT Infrastructure Capabilities | 28 |
| 3.5 Consolidating the IT Infrastructure | 33 |
| 3.6 Factors To Consider In Designing IT Infrastructures | 36 |
| 3.7 Conclusion | 39 |
| 4. RESEARCH METHODOLOGY | 41 |
| 4.1 Research Process | 42 |
| 4.2 Elaboration of the Research Process in Brief..... | 43 |
| 4.3 Selection of theory and objects to study..... | 44 |
| 4.4 Conceptual Model of the Research | 44 |
| 4.5 Research Framework | 45 |
| 4.5.1 Development of Indicators for measurement of the elements of the framework | 45 |
| 4.5.2 The Method to Assess the Technology Capability of a Software Firm..... | 54 |
| 4.6 Sampling | 68 |



University of Moratuwa, Sri Lanka
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

| | |
|---|-----------|
| 4.7 Data Collection | 69 |
| 4.8 Interview Strategy | 70 |
| 4.9 Data Analysis | 70 |
| 4.10 Validity..... | 71 |
| 4.11 Summary..... | 71 |
| 5. COLLECTION OF DATA..... | 72 |
| 5.1 Technology Transfer Mechanisms..... | 73 |
| 5.2 Technologies Transferred | 73 |
| 5.2.1 Process Technology Transfer..... | 73 |
| 5.2.2 Product Technology Transfer | 80 |
| 5.3 Problems Faced in Transferring Technology | 81 |
| 5.3.1 Language..... | 81 |
| 5.3.2 Insufficient Training | 81 |
| 5.3.3 Lack Of Documentation For Development Tools | 81 |
| 5.3.4 Finding Skilled Workers | 81 |
| 5.3.5 Government Regulations and Tariff on Data Communication | 82 |
| 5.3.6 Procedures of Customs Department of Sri Lanka..... | 82 |
| 5.4 Technology Usage | 82 |
| 5.5 Resource Planning Methods..... | 86 |
| 5.6 Technology Needs Assessment Methods | 88 |
| 5.7 Technology Evaluation Methods..... | 89 |
| 5.8 Technology Change | 89 |
| 5.9 Summary..... | 89 |
| 6. FINDINGS..... | 90 |

| | |
|--|------------|
| 7. DISCUSSION..... | 100 |
| 8. DEVELOPMENT OF A INFRASTRUCTURE MANAGEMENT STRATEGY FOR SOFTWARE DEVELOPMENT FIRMS IN SRI LANKA..... | 102 |
| 8.1 Technology Transfer | 104 |
| 8.1.1 Standards..... | 104 |
| 8.1.2 Guidelines and Documentations | 104 |
| 8.1.3 Research and Selection | 105 |
| 8.2 Technology Usage | 106 |
| 8.2.1 Identification | 106 |
| 8.2.2 Selection..... | 106 |
| 8.2.3 Server Consolidation..... | 106 |
| 8.2.4 Monitoring and Tuning | 107 |
| 8.2.5 Budgeting | 108 |
| 8.2.6 Security Implementation..... | 108 |
| 8.3 Resource Planning | 111 |
| 8.3.1 Purchase Plan..... | 111 |
| 8.3.2 Procurement of PCs, Laptops and Desktops..... | 111 |
| 8.3.3 Utilization of Human Resources for Infrastructure Management Tasks.. | 112 |
| 8.3.4 Efficient Inventory Management | 113 |
| 8.3.5 Back Up | 114 |
| 8.3.6 Competency Development..... | 114 |
| 8.4 Technology Needs Assessment | 114 |
| 8.5 Technology Evaluation | 115 |
| 8.6 Technology Change | 115 |
| 8.7 Summary..... | 115 |
| 9. CONCLUSIONS | 116 |

| | |
|---|------------|
| 9.1 Achievement of the Aim and Objectives..... | 117 |
| 9.2 Problems Encountered | 121 |
| 9.2.1 Fact Finding | 121 |
| 9.3 Recommendations for Future Research | 121 |
| REFERENCES | 123 |
| APPENDIX I | 128 |
| Standards..... | 129 |
| Guidelines and documentations..... | 129 |
| APPENDIX II. | 131 |
| APPENDIX III..... | 133 |
| APPENDIX IV | 140 |
| ABBREVIATIONS | 144 |



University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

List of Figures

| | |
|---|-----|
| Figure 1: Types of Infrastructures | 11 |
| Figure 2: Framework to evaluate alternative process infrastructures | 18 |
| Figure 3: Fujitsu's methodology for optimizing IT infrastructure | 20 |
| Figure 4: Four-stage approach of Fujitsu..... | 21 |
| Figure 5: Regions for consolidation..... | 24 |
| Figure 6: Fujitsu general form of the framework | 28 |
| Figure 7: Key Components of IT Infrastructure | 29 |
| Figure 8: Solution areas that meet the business challenge..... | 34 |
| Figure 9: Research Process | 42 |
| Figure 10: Elaboration of the research process in brief..... | 43 |
| Figure 11: Conceptual Model of the Research | 44 |
| Figure 12: Technological capability elements..... | 55 |
| Figure 13: Revenue Vs Resource Planning | 94 |
| Figure 14: Revenue Vs Technology Change | 94 |
| Figure 15: Revenue Vs Technology Evaluation | 95 |
| Figure 16: Revenue Vs Technology Needs Assessment..... | 95 |
| Figure 17: Revenue Vs Technology Transfer..... | 96 |
| Figure 18: Revenue Vs Technology Usage | 96 |
| Figure 19: Infrastructure Expenditure Vs Resource Planning | 97 |
| Figure 20: Infrastructure Expenditure Vs Technology Change..... | 97 |
| Figure 21: Infrastructure Expenditure Vs Technology Evaluation..... | 98 |
| Figure 22: Infrastructure Expenditure Vs Technology Needs Assessment | 98 |
| Figure 23: Infrastructure Expenditure Vs Technology Transfer | 99 |
| Figure 24: Infrastructure Expenditure Vs Technology Usage | 99 |
| Figure 25: Strategy implementation module | 103 |
| Figure 26: Usage of guidelines | 105 |

List of Tables

| | |
|--|-----|
| Table 1: IT functions and benefits | 14 |
| Table 2: Skill set matrix | 38 |
| Table 3 : Skill assessment attributes and characteristics..... | 38 |
| Table 4: Example for the employee assessed..... | 39 |
| Table 5 : Capabilities and their elements | 55 |
| Table 6 : Creation capability elements and possible indicators for their assessment | 59 |
| Table 7 : Creation capability elements and possible indicators for their assessment | 60 |
| Table 8: Design and engineering capability elements and possible indicators for their assessment | 61 |
| Table 9: Design and engineering capability elements and possible indicators for their assessment | 62 |
| Table 10: Business Development Capability | 63 |
| Table 11: Servicing Capability | 64 |
| Table 12: Acquiring capability | 65 |
| Table 13: Supportive capability | 66 |
| Table 14: Steering Capability | 67 |
| Table 15: Sample selection for finding relationship between revenue & infrastructure management components..... | 68 |
| Table 16: Sample selection for finding relationship between infrastructure expenditure & infrastructure management components | 69 |
| Table 17: Strategies of Multinationals and leading software companies for infrastructure management..... | 83 |
| Table 18: Resource Planning Strategies..... | 87 |
| Table 19: Scores of multiple indices of assessment of efficiency for each infrastructure management component element..... | 91 |
| Table 20: Summation of Scores of multiple indices of assessment of efficiency for each infrastructure management component element with weights | 93 |
| Table 21: Correlation between revenue, infrastructure expenditure and infrastructure management components..... | 93 |
| Table 22: Monitoring Criteria | 115 |

Acknowledgements

First I wish to extend my deepest gratitude to Prof. Ananda Jayawardane for the continuous guidance and support. I take this opportunity also to thank Dr. Sarath Dasanayake for his encouragement and support during the research.

Prof. Dayananda of University of Sri Jayawardenapura graciously extended his expertise and experience in statistics. He especially contributed to the analysis of the research.

Mr. Hiran Kandappa is a friend who provided guidance and supported in statistical analysis. I am grateful to him for his valuable contribution for the research.

Thanks to Ramesh Peris, Wajira Wijesinghe, Janaka Rodrigo, Jaliya Jayasuriya, Sunimal Jayasuriya, Asanka Karunanayake, Buddhika Karunathilaka, Muditha Perera, Saminda De Silva, Uditha Welegedara, Senthil Kumaran for the valuable contribution about the software development firms in Sri Lanka.

Many thanks go to my father Mr. K. G Kulasena, Prof. Dissanayake and Dr. G. B Gunawardena for providing reference material, suggestions, guidance and encouragement. My farthers' expertise and experience on management has contributed immensely to the research.

Last, but certainly not least, I must acknowledge the many contributions of my wife Sanduni for offering support and understanding when it was needed.

R. C. K. Gamage.